Southern California Edison

Tools and Technologies for Distribution Resources Plan CPUC Workshop

January 8, 2015

Southern California Edison

Overview

- Integration Capacity Analysis
- Locational Benefits
- Optimal Locations
- Current Tool Capabilities
- Emerging Applications

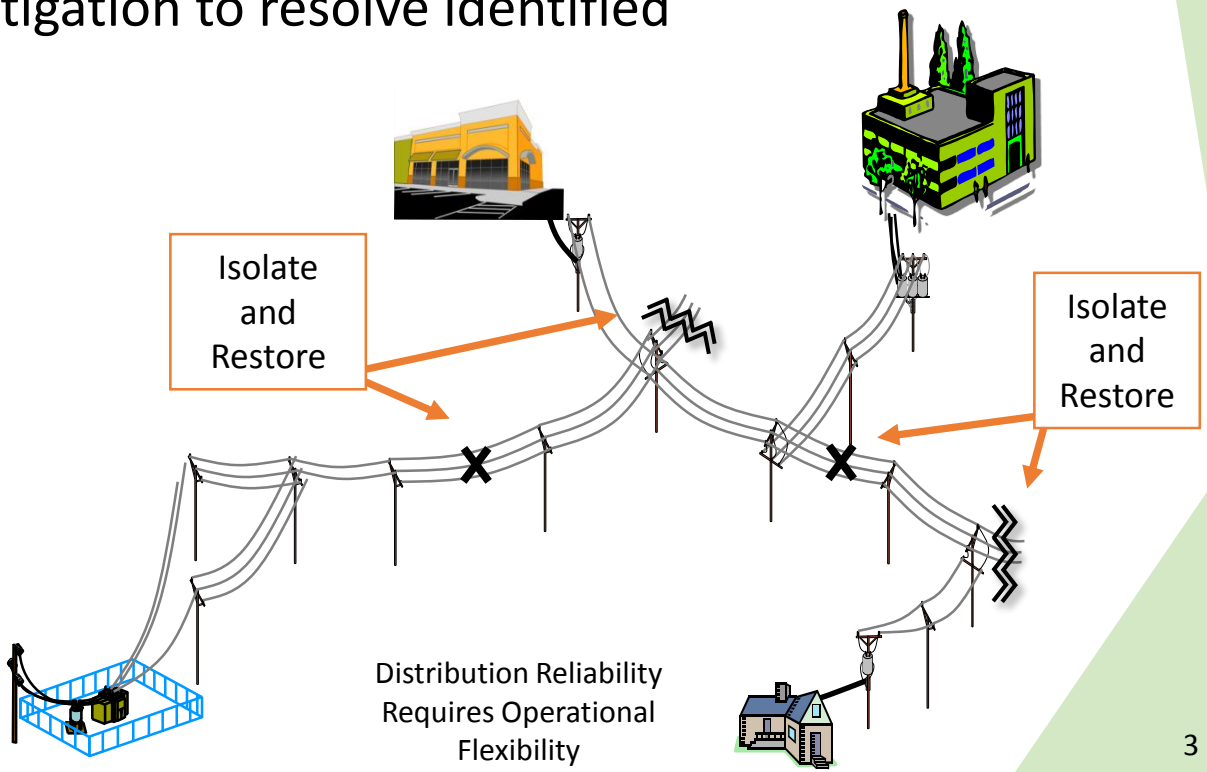
Integration Capacity Analysis

Southern California Edison

Purpose is to visually demonstrate by circuit, the available capacity to accommodate DER

- Identify areas of low reliability or power quality impact
- Accounts for dynamic changes in distribution system configuration
- Not overly restrictive

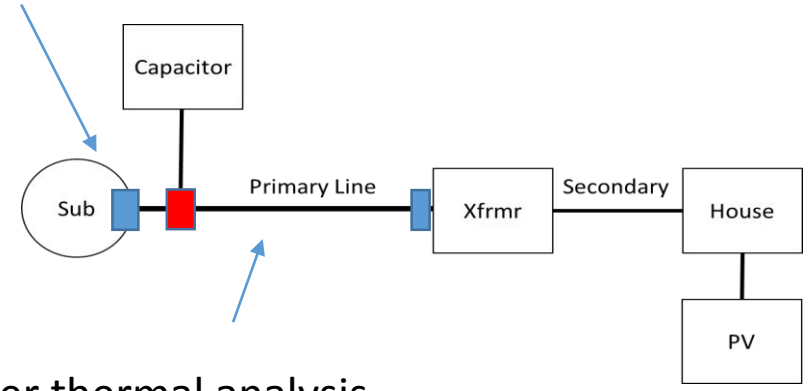
- Should enable system solutions and mitigation to resolve identified constraints
  - Prevents being overly restrictive
  - Similar to load planning (plug and play)
  - Allow for reconfiguration to resolve constraints
  - Recognizes ability to co-optimize between DER technologies
- ICA is based on constraints driven by thermal, protection primarily



Southern California Edison

Distribution Analysis

Feeder protection limitations



Feeder thermal analysis

Larger upgrades required for protection and thermal overload

Typically, power quality mitigated through addition of voltage regulation devices, ramping, smart inverters (future)

Constraints vary largely by geographical differences between urban and rural locations, can be captured by representative feeder models

$$\text{Distribution Upgrade} = \sum \text{Costs to upgrade distribution circuit components}$$

Southern California Edison

Clustering Distribution Circuit Models

- Purpose
  - To analyze the diversity of feeders in SCE territory, but without dedicating resources to validate, simulate, and analyze 4500 circuits
- Clustering Criteria used to weight more important factors
- 17 dimensions including
  - Infrastructure configurations
  - Loading
  - Demographics
  - Climate Zones
  - Urban & Rural
- Settled on a set of 30 representative feeders with varying weights

Southern California Edison

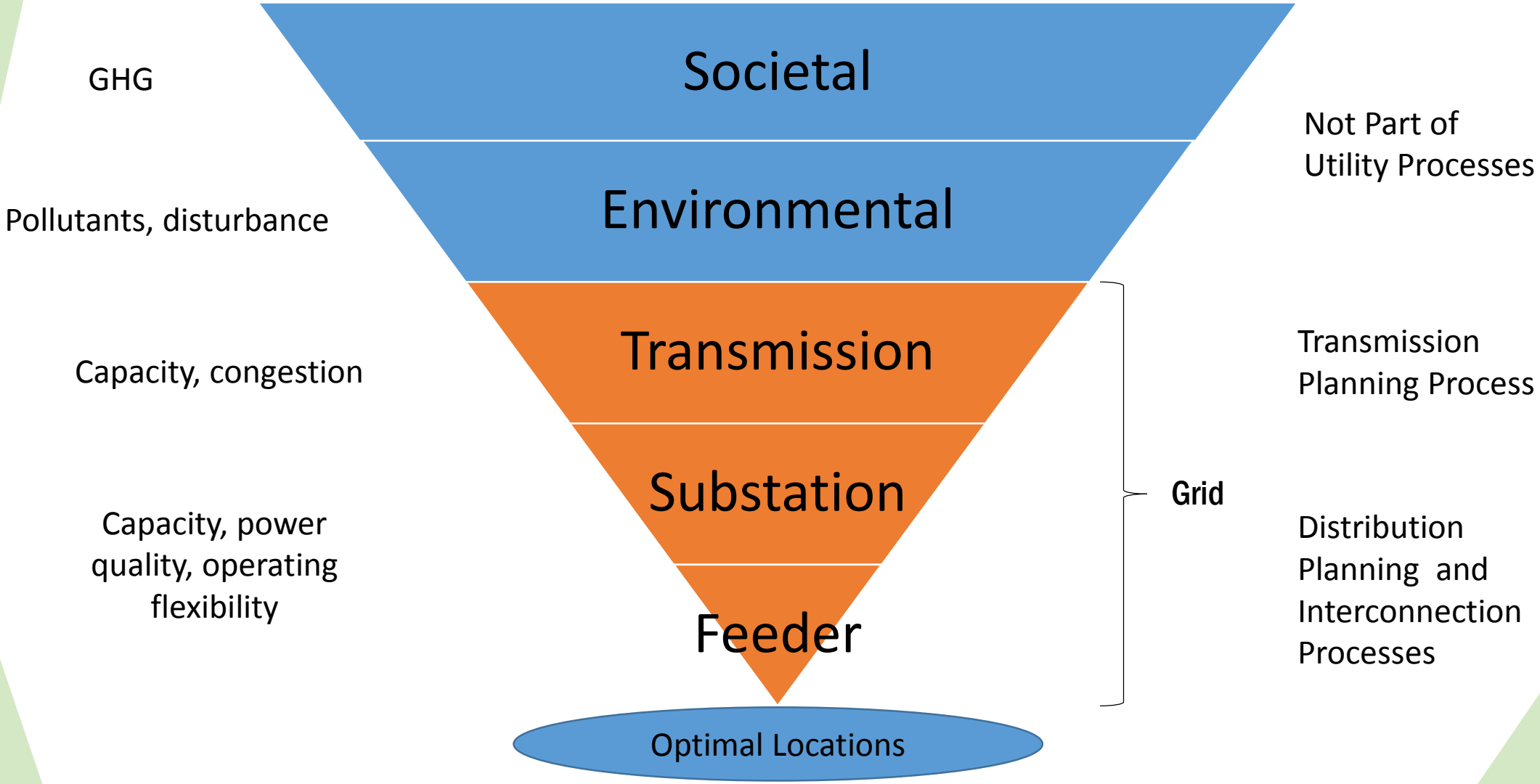
Integration Capacity Analysis Methodology

- Analyze representative circuits to:
  - Perform in-depth study of multiple scenarios between urban and rural networks
    - Building on the CEC DER pilot study started in 2013
  - Develop engineering criteria based on limitations and operational flexibility
  - Incorporate initially into current planning tools
- Apply engineering criteria to balance of circuits
  - Identify thermal and protection limitations
- If available, validate with other hosting capacity calculation methodologies and tools
- Create “heat map” results onto modified RAM maps
- Incorporating DER planning into system planning drives closer to a “grid as network” plug and play environment

Southern California Edison

Net Benefits – Avoided Costs

Illustrative

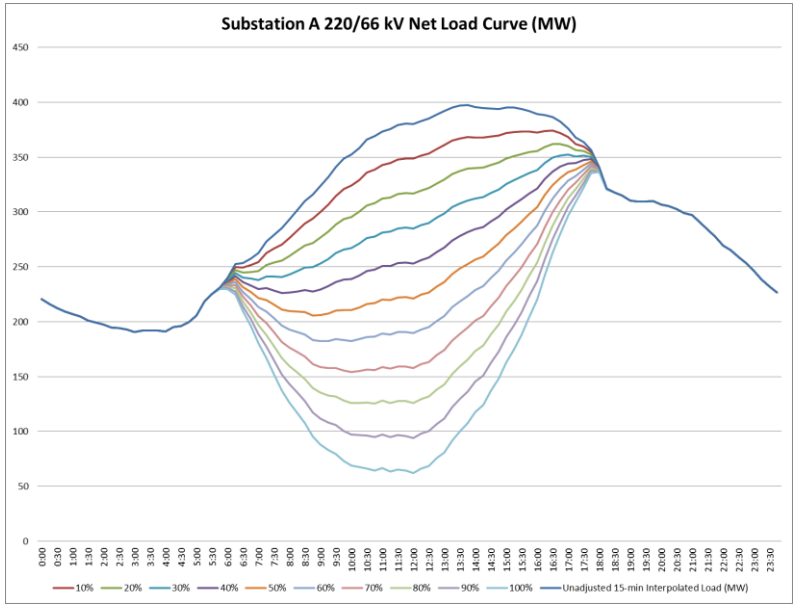


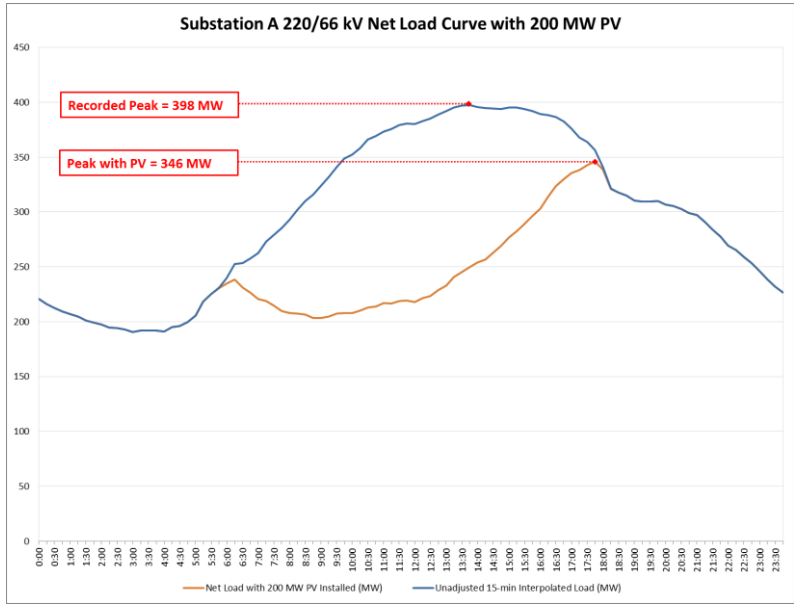
Southern California Edison

Grid Benefit

- Evaluate resources and ability to meet distribution planning needs
  - Expected resource profile
  - Coincidence with demand profile
- Identify locations with:
  - Distribution upgrades
  - High utilization

PV Example



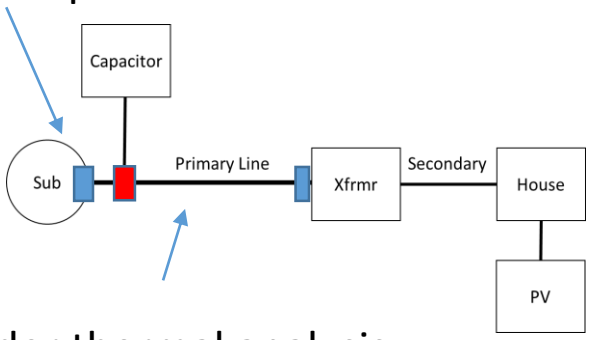


Southern California Edison

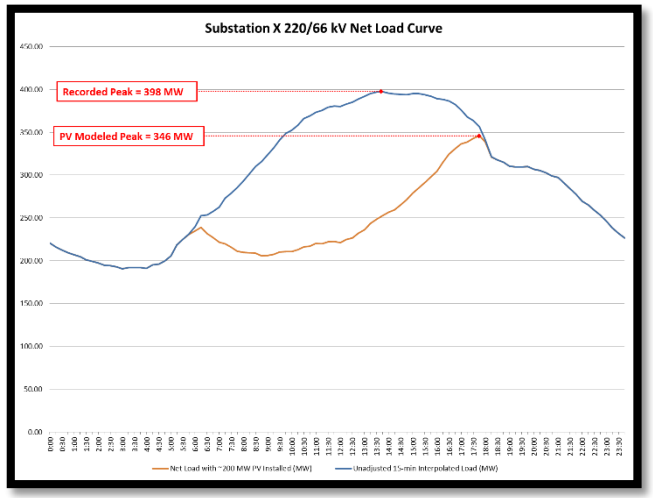
Optimal Locations

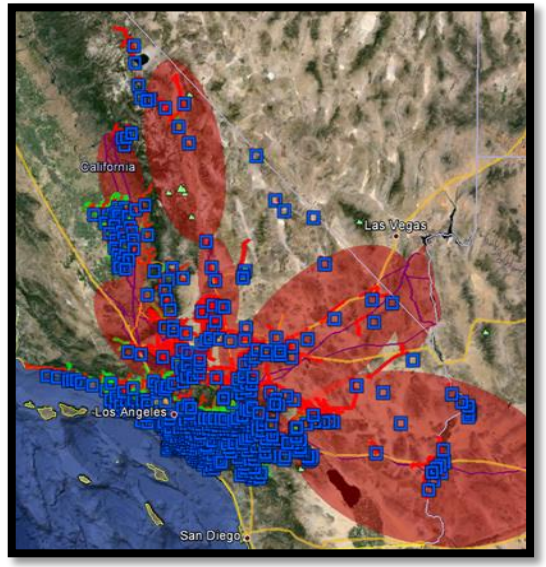
Integration Capacity Analysis → Net Benefit Analysis → Optimal Locations

Feeder protection limitations



Feeder thermal analysis





Output of available capacity to integrate DERs across electric grid

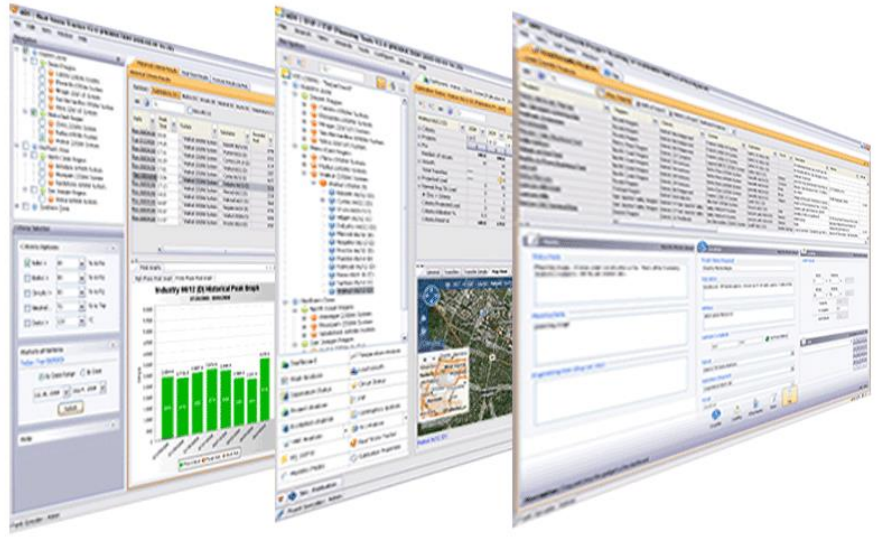
Evaluation of distributed resources and potential for providing grid benefit

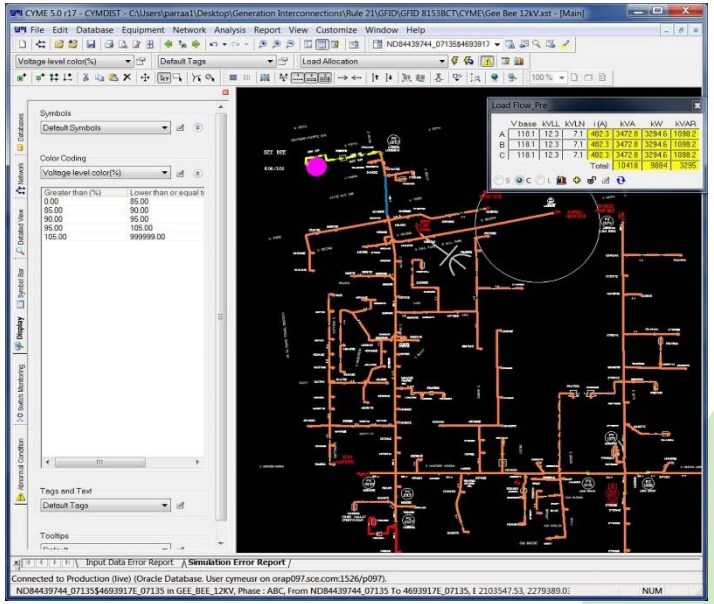
Geographic display of outputs

Southern California Edison

Current Tool Capabilities

- In-house planning tool for peak load planning
  - Substation and circuit capacity is modeled
  - SCADA data is used to develop peak forecast
  - Capital project and alternative analysis
- Common distribution and network load flow programs
- Allocation methods for DER forecasts
- Allocation methods to integrate distribution and transmission planning processes





Southern California Edison

Emerging Applications

- Interconnection application processing
- 10-year load forecasting with DER integration
  - Evaluation of characteristic profiles
  - Optimal portfolios of DERs to meet grid needs
- Locational net benefits analysis
- Time-Series analysis
- Grid Management System – integration of operational systems to ensure situational awareness, safety, and reliability

Southern California Edison

Questions